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Detecting Anthropogenic Changes in Atmospheric Temperatures in Microwave Sounder Measurements Using Multi Model Fingerprint Techniques

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Abstract: Previous detection and attribution studies performed on satellite measurements of atmospheric temperature have relied on methods that employ one or at most two climate models. The models are used to generate a ―fingerprint‖ of anthropogenic change, and this fingerprint is then searched for in the satellite observations. Such investigations have claimed successful detection of significant anthropogenic changes in tropospheric and stratospheric temperatures. It is not clear whether the findings of these studies are overly dependent on the specific behavior of the model used in the analysis. Such questions can be addressed using a true ―multi-model‖ detection and attribution analysis, in which pooled data from many different climate models is employed for both fingerprint estimation and for estimating the noise of natural internal climate variability, and differences between simulated changes in each model are used to estimate model uncertainty. Multi-model analyses should produce more robust and credible detection results. We propose to calculate fingerprints of anthropogenic change using the pooled data from nearly two dozen climate models. A large number of model simulations of the 20th century climate were performed in support of the IPCC AR4 report. We propose to use the output from these runs to calculate multi-model fingerprints of anthropogenic change. We will also analyze the pooled information from multiple model control runs to obtain information on the amplitude and structure of natural internal variability.
The model fingerprints will be searched for in the multi-decadal records of atmospheric temperature in four layers from the lower troposphere to the lower stratosphere, constructed from microwave sounding measurements made by the MSU/AMSU series of instruments. Optimal fingerprinting techniques will be used to determine whether the correspondence between the modeled and observed patterns of temperature change could be due to internal variability alone. Data from so-called ―single forcing‖ runs performed with several different climate models will be used to estimate the contributions of different forcing agents to the detected temperature changes.